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CO-040-11 Certified Return Receipt # 7009 1410 0002 2822 2871

March 21, 2011

Mr. Brian Jackson
Alaska Department of Environmental Conservation
Division of Spill Prevention and Response
Prevention & Emergency Response Program
610 University Ave
Fairbanks, Alaska 99709-3643

RE: Flint Hills Resources Alaska, LLC, North Pole Refinery
Final Laboratory Area Subsurface Investigation Work Plan
DEC File Number 100.38.090

Dear Mr. Jackson:

Please find attached the Final Laboratory Area Subsurface Investigation Work Plan (Work Plan) for the Flint Hills Resources, Alaska (FHRA) North Pole Refinery. This Work Plan was prepared at the request of the Alaska Department of Environmental Conservation (ADEC) to assess soil conditions beneath the refinery quality control laboratory. Subsequent to our discussions, Figure 2 has been modified to more accurately reflect the drain line location in the hydrocarbons laboratory. Also, calculations for estimated release volumes are ongoing and will be submitted under separate cover (as noted in the Introduction). Field activities have been scheduled for the week of March 28.

If you have any questions, or would like to discuss the proposed work in more detail, please feel free to contact me at (907) 490-6229, or Elizabeth Page at (817) 842-9070.
Sincerely,

Daren Knowles
Environmental, Health, and Safety Manager
Flint Hills Resources Alaska, LLC

Cc: Elizabeth Page – Reiss Remediation
Rebecca Andresen - ARCADIS

Imagine the result

Flint Hills Resources Alaska

Laboratory Area Subsurface Investigation Work Plan

Flint Hills Resources Alaska
North Pole Refinery

ADEC File Number: 100.38.090

March 17, 2011

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Infrastructure Water Environment Buildings

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Laboratory Area Subsurface Investigation Work Plan

Flint Hills Resources Alaska
North Pole Refinery

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March 17, 2011

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Appendix A Project Personnel Resumes

Appendix B Chemicals of Concern in Laboratory Sump

Appendix C Human Health Conceptual Site Model - On-Site

ADEC	Alaska Department of Environmental Conservation
COC	chain-of-custody
COPC	contaminant of potential concern
CSM	Conceptual Site Model
CSP	Contaminated Sites Program
DRO	diesel-range organics
FHRA	Flint Hills Resources Alaska
GRO	gasoline range organics
HHRA	Human Health Risk Assessment
MeOH	methanol
mL	milliliter
NPR	North Pole Refinery
PID	photo ionization detector
QA	quality assurance
QC	quality control
RRO	residual range organics
SCL	soil cleanup level
SCWP	Site Characterization Work Plan
SDG	sample delivery group
SGS	SGS Environmental Services, Inc.

site	Flint Hills Resources Alaska quality control laboratory at the North Pole Refinery in North Pole, Alaska
SPAR	Spill Prevention and Response
SVOC	semivolatile organic compound
VOC	volatile organic compound
work plan	Subsurface Investigation Work Plan

1. Introduction

This Subsurface Investigation Work Plan (work plan) has been prepared to guide an investigation of shallow subsurface conditions and soil quality beneath the Flint Hills Resources Alaska (FHRA) quality control (QC) laboratory at the North Pole Refinery (NPR) in North Pole, Alaska (site). In July 2010, a hydrostatic pressure test of the laboratory drainage piping indicated that the subsurface piping system would not maintain a static water level when the piping system was isolated and filled with water. On July 21, 2010, FHRA reported these test results by letter to the Alaska Department of Environmental Conservation (ADEC). This work plan provides sampling and analysis procedures for a subsurface investigation of the soil quality beneath the FHRA QC laboratory. The site and surrounding features are shown on Figure 1.

Activities to be performed as part of this work plan include the installation and sampling of five soil boring locations to provide information on the subsurface soil conditions and soil quality beneath the FHRA QC laboratory building. Activities discussed in this work plan will be conducted by ARCADIS field staff. Subcontractors and/or FHRA employees may assist with technical aspects of the soil boring installation. All proposed work will be conducted under the direction of ARCADIS field staff who meet the criteria for a “qualified person” [18 AAC 75.990 (100), and 18AAC 78.995 (118)]. Resumes for project personnel are included in Appendix A.

The installation of the soil borings is scheduled for late March to take advantage of weather conditions. A draft Investigation Results Report will be completed within approximately 6 weeks of acceptance of the final laboratory results.

The following tasks are part of the subsurface investigation and are discussed in this work plan:

- soil boring installation
- collection of soil samples from soil borings
- selection of parameters and analytes
- preservation and handling of soil samples
- identification of analytical procedures and laboratory QC requirements
- documentation of field sampling procedures including sample identification and chain-of-custody (COC) protocols

- field quality assurance (QA) and QC procedures

This work plan also is intended to provide responses to ADEC's letter dated December 22, 2010 regarding the Sump Investigation Report and Investigation Closure Request submitted by FHRA. In its letter, ADEC requested volume estimates and an investigation plan for the four sumps that failed the integrity testing conducted by FHRA. Each of the four sumps is discussed in more detail within this work plan. Release estimates for two of the four FHRA sump systems are ongoing and will be submitted to ADEC under separate cover.

2. Site Description

The NPR is a petroleum refinery that was purchased by FHRA from Williams Alaska Petroleum, Inc. in 2004. The NPR is located just outside the city limits of the city of North Pole, Alaska. North Pole is located approximately 13 miles southeast of Fairbanks, Alaska, within the Fairbanks North Star Borough. The NPR is located at 1100 H&H Lane in North Pole, Alaska, with an approximate latitude and longitude center point located at 64.74 N and 147.35 W.

Comprehensive site characterization activities are currently in progress to evaluate residual and dissolved-phase impacts associated with historical NPR operations. Regulatory oversight for the characterization activities is provided by the ADEC Division of Spill Prevention and Response (SPAR) Contaminated Sites Program (CSP). As part of the characterization activities, a third-party inspection contractor was obtained to inspect the integrity of sumps and drain lines associated with NPR operations. A total of 42 sump systems were inspected, beginning in 2009 and continuing until all inspections were completed in 2010. Four sump systems and the QC laboratory drain lines were found to have potentially compromised integrity. This section describes the limited environmental assessment activities that were conducted during the repair and/or replacement of the four sump systems with potentially compromised integrity. Release estimate calculations for two of the four sump systems are on-going, and will be submitted under separate cover.

2.1 Asphalt Sump (03-6)

During a 2010 visual inspection, the Asphalt Sump was found to have general corrosion and pitting in the shell and two nozzle leaks. During cleaning and inspection of the sump, it was decided to replace the entire sump. FHRA initially reported a potential release to ADEC for this sump, but has since determined that sand blasting during sump cleaning activities caused the observed shell perforations. In light of this determination FHRA has concluded that there was no release from this sump so the estimated release volume is zero. One soil sample was collected from the surplus soil following installation of the new sump. Concentrations of diesel-range organics (DRO) in the soil sample were less than the soil cleanup level (SCL) for direct soil exposure, but exceeded the SCLs for the soil-to-groundwater pathway. The Asphalt Sump is located approximately 150 and 260 feet upgradient from monitoring wells MW-138 and MW-115, respectively. Impacts to groundwater potentially occurring from this sump system through the soil-to-groundwater pathway will be sufficiently monitored by these wells and the entire monitoring well system at the FHRA NPR.

2.2 Blend Building Sump (05-7)

The Blend Building Sump was found to have corrosion in various places, as well as a drain line from the building that did not pass static hydro-testing for tightness. The sump was repaired using concrete and additional welding, and the drain line assembly and two cleanout fittings were excavated and replaced underneath the blend building.. FHRA is currently evaluating methods that may allow for development of an estimated spill volume for this sump.

Two soil samples were collected from the open excavations beneath the concrete floor slab of the blend building during drain line repairs. Soil concentrations did not exceed the SCLs for direct soil exposure, but several analytes did exceed the SCLs for the soil-to-groundwater pathway. The Blend Building Sump is located approximately 3 feet from monitoring well MW-115. Impacts to groundwater potentially resulting from the soil-to-groundwater pathway would be present in well MW-115 and are being monitored regularly during groundwater sampling events of the monitoring well network at the FHRA NPR. In addition, this sump is located within the capture zone of the current on-site groundwater capture remediation system, which is undergoing upgrades as part of the current Interim Remedial Action Plan for the site.

Additional drivers for relying on the current on-site groundwater capture remediation system verses performing subsurface investigations of the sump or adjacent area would be the potential safety hazards and risk associated with performing work in this area. The sump is located within a process area that is subject to Area Classification standards. The area is classified as Class 1 Div 2. This Area Classification indicates that if there were a flammable release, it would be within the flammable range for ignition and possibly explosion. There is also underground piping within the area, the potential of striking a pipe while performing subsurface drilling and/or boring is very high. Overhead hazards could potentially limit access and operation of certain types of equipment. Additionally, the sump is located in a confined area in extremely close proximity to operational process equipment that the drilling and/or boring equipment would need to access to perform work. Based the proximity of existing nearby monitoring wells and the encompassing groundwater system capture zone, FHR does not believe the effort to investigate this confined area would provide sufficient useful data to risk human safety and equipment damage.

2.3 Tank Farm Truck Kero Sump (922)

The Tank Farm Truck Kero Sump was found to have a potential defect during a mechanical integrity inspection. FHRA initially reported to ADEC that a potential release had occurred. Upon further inspection no visual defects were found and FHRA was unable to find any breach in integrity of the sump or piping. In light of this determination FHRA has concluded that there was no release from this sump so the estimated release volume is zero The entire sump assembly was replaced due to age and end-of-service life considerations. Soil samples were collected during replacement of the sump. Soil concentrations did not exceed the SCLs for direct soil exposure, but several analytes did exceed the SCLs for the soil-to-groundwater pathway. Sulfolane was not detected in the soil samples. Hydrocarbon impacts in the subsurface in this area are expected based on historical releases and are unlikely due to leaks or failures from this sump system. The Tank Farm Truck Kero Sump is located within the NPR tank farm where numerous historical hydrocarbon releases are known to have taken place. Hydrocarbon impacts in this area are currently being addressed by the groundwater capture remediation system, which is undergoing upgrades as part of the current Interim Remedial Action Plan for the site. The Tank Farm Truck Kero Sump is located approximately 75 feet upgradient from monitoring well MW-130. Impacts to groundwater potentially occurring from this sump system through the soil-to-groundwater pathway will be sufficiently monitored by this well and the entire monitoring well system at the FHRA NPR.

2.4 Naphtha 2 Sump (02/04-2)

The Naphtha 2 Sump had no identifiable leaks during a visual inspection in 2009. However, an improperly installed nozzle was identified and fixed. One of the gravity drain lines feeding the sump did not pass tightness testing and could not be successfully repaired. FHRA is currently evaluating methods that may allow for development of an estimated spill volume for this sump.

The entire drain line was abandoned and isolated from the sump. No soil samples were collected during the sump investigation and repair because no excavation was performed. However, it appears that any fuel hydrocarbons that were potentially released to the subsurface from this sump or its drain lines have been or would be captured by the current groundwater capture remediation system. The Naphtha 2 Sump is located approximately 3 feet side gradient from monitoring well MW-115. Impacts to groundwater potentially occurring from this sump system through the soil-to-groundwater pathway will be sufficiently monitored by this well and the entire monitoring well system at the FHRA NPR. Furthermore, upgrades to the remediation system are being installed by FHRA to address capture and treatment of sulfolane.

Additional drivers for relying on the current on-site groundwater capture remediation system verses performing subsurface investigations of the sump or adjacent area would be the potential safety hazards and risk associated with performing work in this area. The sump is located within a process area that is subject to Area Classification standards. The area is classified as Class 1 Div 2. This Area Classification indicates that if there were a flammable release, it would be within the flammable range for ignition and possibly explosion. There is also underground piping within the area, the potential of striking a pipe while performing subsurface drilling and/or boring is very high. Overhead hazards could potentially limit access and operation of certain types of equipment. Additionally, the sump is located in a confined area in extremely close proximity to operational process equipment that the drilling and/or boring equipment would need to access to perform work. Based on the proximity of existing nearby monitoring wells and the encompassing groundwater system capture zone, FHRA does not believe the effort to investigate this confined area would provide sufficient useful data to risk human safety and equipment damage.

2.5 Laboratory Sump Piping

The laboratory sump piping system was inspected using hydrostatic testing and a flexiprobe camera. The piping system failed hydrostatic testing due to the use of an incorrect type of gasket during construction of the piping system. Neoprene gaskets were used, which are not the correct application for hydrocarbon service. The drain system was designed and constructed prior to FHRA's ownership of the NPR. Inspection of the lab sump piping system identified no failures. As a result of testing performed on the laboratory sump piping system, the laboratory sump piping was removed from service and a temporary piping system was installed. Areas of the drains that failed hydrostatic testing are located beneath the concrete laboratory floor. At the request of ADEC, soil samples will be collected beneath the laboratory floor to characterize potential impacts. The ability to collect soil samples will be limited due to the tight space restrictions of the laboratory area, the sensitive instrumentation used in the laboratory and the regular schedule of work conducted in the laboratory. Proposed soil sampling locations are shown on Figure 2.

2.6 Laboratory Drain Backup

On January 19, 2011, FHRA laboratory workers noticed the abandoned floor drains in the new asphalt lab were backing up with water. All running water was immediately shut off. The sump level and sump pump were inspected and found to be operating normally. To find the cause of the drain backup the water supply in multiple sinks in the laboratory area were systematically turned on until the water level in the drains began to rise. The water supply in the octane room sink caused the water level in the drains to rise. The piping system for the octane room sink was then inspected and a previously unknown pipe tee was found which tied into the building's old drain system. The sink drain system was then modified so that the octane room sink will drain into the new drain line system only. A vacuum truck was used to evacuate the abandoned drain line of any residual water and the drain line was isolated. There was no release to the environment caused by the drain line backup. The contents of the backed up drains were contained by the tile flooring in the laboratory building and were cleaned up by FHRA personnel. The backup in the drain lines is not expected to have caused a release to the subsurface; however, sampling proposed to evaluate the overall integrity of the laboratory drain line system (Section 5, below), is adequate to evaluate any additional potential impacts. Sink locations are shown on Figure 2.

3. Contaminants of Potential Concern

A table of chemicals and products used in the FHRA QC laboratory was provided to the ADEC in the FHRA submittal to ADEC SPAR (FHRA, July 2010) and is presented in Appendix B for reference. Based on these data, the soil samples will be analyzed for the indicator analytes presented in the table below.

Contaminants of Potential Concern	Soil Cleanup Level (mg/kg)	Laboratory Method	Detection Limit: Soil (mg/kg)
Gasoline range organics (GRO)	300	Alaska Method AK 101	0.6
DRO	250	Alaska Method AK 102	4.4
Residual range organics (RRO)	11,000	Alaska Method AK 103	4.4
Semivolatile organic compounds (SVOCs)	NA	USEPA Method 8270D	NA
Volatile organic compound (VOCs)	NA	USEPA Method 8260B	NA
RCRA 8 Metals	NA	USEPA Method SW 6020/7471B	NA
Sulfolane	ND	USEPA Method 8260B	ND

Notes:
mg/kg = milligrams per kilogram

NA = SVOCs, VOCs and RCRA Metals consist of many individual analytes, which have individual soil cleanup levels and detection limits. Individual cleanup levels are available on ADEC18 AAC 75 Oil and Other Hazardous Substances Pollution Control, rev. October 9, 2008; Table B1. Method Two – Soil Cleanup Levels.

ND = Not determined, soil cleanup levels and detection limits have not been established.

RCRA = Resource, Conservation and Recovery Act

USEPA = United States Environmental Protection Agency

4. Preliminary Site Conceptual Model

A Preliminary Human Health Conceptual Site Model (CSM) was prepared for the NPR and submitted with the Site Characterization Work Plan (SCWP; Barr 2010). The Preliminary Human Health CSM indicated that potentially complete pathways for contaminants of potential concern (COPCs) at the site include:

- incidental soil ingestion
- dermal absorption of contaminants from soil
- dermal absorption of contaminants in groundwater
- inhalation of outdoor air
- inhalation of indoor air
- inhalation of fugitive dust

The Preliminary Human Health CSM is included as Appendix C to this work plan.

The preliminary CSM developed for the SCWP (Barr 2010) includes all of the on-site operations at the NPR, but can be further refined for areas surrounding those sumps with potential integrity issues. Data collected during the sump investigations indicate that COPC concentrations are not present in soil at concentrations exceeding the applicable standards for direct contact. Therefore, the dermal absorption exposure pathway for soil can be eliminated for these areas only. Furthermore, each of the sump failures occurred beneath structures; therefore, the likelihood of inhalation of fugitive dust is insignificant and can be removed as a potential exposure pathway for the sump areas.

Remaining potential exposure pathways for releases associated with the sump areas include incidental soil ingestion, dermal absorption of groundwater and inhalation of vapors from soil and/or groundwater impacts. An extensive network of groundwater monitoring wells is located on site and off site, and an established groundwater monitoring program is conducted by FHRA under oversight by the ADEC CSP. The monitoring well network is sufficient to monitor potential groundwater impacts from releases at the sump area (Figure 3). Data collected from the groundwater monitoring wells, soil data collected as part of the SCWP (Barr 2010), as well as data collected during the sump investigations will be used to develop a Human Health Risk Assessment (HHRA) for this site. The results of the HHRA will be used to determine if and where further remedial action (and/or site characterization) will be required.

Environmental data have not been collected to determine if the line failures in the FHRA QC laboratory have contributed to a release to soil or groundwater beneath the laboratory building. At the request of ADEC SPAR Program, additional assessment activities are proposed to evaluate soil conditions beneath the FHRA QC laboratory. The assessment activities, described in Section 5, will be used in conjunction with groundwater data from the existing monitoring well network to update a CSM for the laboratory area.

5. Limited Site Investigation

Temporary soil borings are proposed at five locations beneath the laboratory building to assess the potential for a release from the suspect drain lines. The soil boring locations were selected based on the drain usages in the FHRA QC laboratory and on a hydrostatic evaluation of the drain lines of the laboratory building. The boring locations were placed near drains and drain lines that were classified as "high use" by laboratory personnel, and are lines that also failed hydrostatic integrity testing. These locations will provide the highest probability of encountering possibly impacted soils resulting from laboratory drain line failures. The proposed locations may be adjusted in the field to avoid obstacles, utilities or other subsurface structures that may be encountered. Any deviations from this work plan will be clearly documented by field personnel and will be communicated to the ADEC. The locations of the proposed soil borings are shown on Figure 2.

To access soils beneath the laboratory building, the concrete floor of the laboratory building will be cut by a concrete cutting contractor. Prior to cutting the concrete, FHRA will be responsible for verifying the locations of the underground utilities and will mark locations suitable for soil boring installation. Depending on the results of underground utility locations, the soil borings may be relocated. The boring locations will be placed as close to their original designations as possible without compromising underground utilities in the FHRA QC laboratory. Based on a site visit by ARCADIS personnel, it is suspected that the drain lines may have been installed within the concrete of the laboratory floor. If this is the case, it will be confirmed during the concrete cutting activities and the condition of the piping and the concrete will be noted by ARCADIS field personnel and photo-documented. The presence of cracking, instability and/or staining in the concrete as well as the condition of the piping within the concrete will be noted.

Upon removal of the concrete from each boring location, a hand auger and other manual methods will be used to reach the desired sampling depth. Mechanical methods of reaching the sampling depths have been considered, such as power augers and hydraulic post hole installing equipment. However, due to the special considerations of the FHRA QC laboratory and its equipment, hand auguring and manual methods were selected to reduce the amount of exhaust, fumes, dust and vibrations that could potentially damage the sensitive laboratory equipment and interfere with laboratory operations. Boring installation activities will be coordinated and phased to minimize interruptions to laboratory operations.

5.1 Soil Sample Collection

The subsurface material beneath the laboratory building is reportedly compacted gravel bedding placed during construction of the building. The depth of the gravel is unknown. Soil samples will be collected as close to the groundwater interface as possible. Depth to groundwater is estimated to be approximately 8 feet below ground surface. Soil samples will be collected for laboratory analysis just above the groundwater interface. However, due to the possible densities of subsurface native soils and the equipment available for use, it may not be possible to reach the total depth desired. If refusal is met and it is not possible to reach the total depth, one soil sample will be collected for laboratory analysis below the depth of the suspected drain lines, as close to the groundwater interface as possible or where field screening indicates potential impacts may be present. If it is not possible to auger through the native material beneath the gravel backfill layer, one soil sample will be collected at the gravel and native layer interface, because this is where potential impacts may be located due to the relative permeability of the gravel layer and impermeability of the denser native layer. ARCADIS field staff will collect and handle analytical samples in accordance with the Draft Field Sampling Guidance (ADEC 2010).

5.2 Field Screening

Field screening of soil samples will be performed continuously during soil boring installation activities using a photo ionization detector (PID) and visual classification. Soils from every 1 foot will be placed into a sealable plastic bag and allowed to volatilize for at least 10 minutes, but no more than 60 minutes. A PID will then be inserted into a small opening of the plastic bag and used to read the level of VOCs in the bag. The VOC reading will be recorded on the boring logs and field sheets used to document boring activities. Field screening for volatiles will also include a visual inspection of soils for the presence of light nonaqueous-phase liquids, hydrocarbon odor or hydrocarbon sheen on the soils. Lithology descriptions and soil classifications will be conducted by trained ARCADIS field staff, recorded on boring logs and included in completion reporting.

5.3 Additional Investigation

Hydrocarbon concentrations in soils encountered during the sump investigation activities did not exceed SCLs for the direct soil exposure pathway. However, they did exceed SCLs for the soil-to-groundwater pathway. To monitor the pathway and transport of hydrocarbons in the soils near these sump systems, ARCADIS proposes to use the existing monitoring well network at the FHRA NPR. The current monitoring well network consists of 100 monitoring wells throughout the NPR, including downgradient areas near the sump systems in question. Several safety issues are associated with conducting drilling activities in the NPR, especially near active components with underground structures and piping, such as the sumps and drains. Furthermore, it would be inadvisable to breach containment areas by drilling adjacent to sumps and drains that are located within such areas. Because of the proximity of existing monitoring wells, ARCADIS believes that additional groundwater monitoring points will not provide additional useful data in these areas; the current monitoring network is sufficient to monitor impacts potentially originating from the sump systems.

6. Field Quality Assurance/Quality Control

The field QA/QC program includes collection of duplicate samples and trip blanks. Descriptions of QA/QC samples are presented below.

6.1 Trip Blanks

A trip blank will be used to detect and quantify potential VOC cross-contamination among the soil samples, or contamination from an outside source that may have occurred during sampling or transportation to the laboratory. One bottle set for each cooler containing VOC samples will be filled with deionized water by the laboratory prior to field mobilization. These bottles will be transported to the sampling location and returned to the laboratory in the cooler used to transport soil samples. The trip blank will be analyzed for the same VOC parameters as the soil samples. The concentration of any artifact found in the trip blank will be noted and compared to the soil sample results.

6.2 Duplicate Samples

Duplicate samples will be collected during the soil boring installation event, from locations with the highest potential to be contaminated, based on field screening results. Duplicate samples will be collected blindly in the field, concurrently with field samples. The location of the duplicate samples will be entered on the boring log and field notes. The duplicate samples will be analyzed using the same analytical methods used for the primary sample. Results of the analysis will be used as a check for repeatability in the analytical procedures. Duplicates will be collected at a rate of one duplicate sample for every 10 field samples, with a minimum of one duplicate sample collected. Matrix spike and matrix spike duplicate samples will be analyzed by the laboratory using a subset of the environmental samples collected for this project. The laboratory will be instructed to perform the analyses for this project in one sample delivery group (SDG), and not split the analyses among two or more SDGs.

6.3 Sample Containers and Handling

Containers used to transport samples for laboratory analyses will be provided by the laboratory performing the analyses. The bottles will be prepared by the laboratory according to the method used for analysis. The bottles will not be opened until immediately before the samples are collected.

Chemical preservatives will be added to the sample containers by the laboratory performing the analyses. Samples will be preserved in the field by placing the samples in an iced, insulated cooler immediately after sample collection. Upon receipt of the samples, authorized laboratory personnel will store and/or prepare the samples for analysis, considering sample holding times for the analytical parameter of interest.

6.4 Temperature Blanks

Temperature blanks will enable the receiving laboratory to determine the temperature at which the samples arrive at the laboratory. Temperature blanks will consist of a jar filled with water and packed with the other samples in each cooler. The water temperature in the blank is measured at the laboratory. Sample temperature should be within a range of 2 to 6 degrees Celsius (°C). The laboratory will document cooler conditions, including measuring temperature blanks upon arrival at each laboratory location, and any occurrence of broken sample containers.

6.5 Sample Shipping

Sample bottles will be wrapped in bubble wrap, placed into the cooler and packed with ice. Packing material will be used as necessary to prevent bottle breakage. A temperature blank will be placed in the cooler prior to shipment. Samples will be labeled for shipment or transfer to the appropriate laboratory. To the extent practical, samples will be shipped as one SDG and may be held by the field technician prior to shipment, if necessary. All VOC samples will be shipped in the same cooler to minimize the need for multiple trip blanks.

Samples will be shipped directly to the laboratory and each cooler will be custody-sealed. If the cooler is to be transferred to the laboratory receiving office, the custody seal will be added by the shipper before shipment. If custody is to be relinquished to a shipper, field personnel will contact the laboratory sample custodian to inform the laboratory of the expected time of arrival of the shipment and any special requirements or time constraints for sample analysis. Any special conditions or requirements will be noted on the COC.

6.6 Equipment Decontamination and Investigation-Derived Waste Management

All nondisposable equipment and tooling introduced into the soil boring, or coming in contact with soil from the soil boring, must be decontaminated prior to use and reuse. To the extent practical, sampling equipment and supplies will be single-use and will not need decontamination prior to disposal. The decontamination procedures for nondisposable sampling equipment and tooling are provided below:

1. nonphosphate detergent wash
2. tap water rinse
3. three final distilled water rinses

Investigation-derived waste will include equipment decontamination fluids. Soils removed from the soil borings will be used for laboratory samples or as backfill material.

Used soapy and rinse water from decontaminating sampling equipment will be placed in 5-gallon buckets or other suitable containers and disposed of in the NPR's wastewater treatment system, following coordination with the NPR's environmental staff.

7. Sample and Field Documentation

A sample documentation program will be implemented to document possession and handling of soil samples from field collection through laboratory analysis. The program will include sample labels, sample-cooler custody seals, COC documentation and sample-receipt documentation from the laboratory.

To prevent misidentification of samples, legible labels will be affixed to each sample container. The labels will be sufficiently durable to remain legible even when wet and will include the sampling point identification name/number, name or initials of collector, date and time of collection, and the required analysis. Samples will be identified using the following format: SBLAB-Number-Beginning depth-ending depth. The designation “SBLAB” represents that the sample was collected from a soil boring installed beneath the laboratory , followed by the soil boring identification number (SBLAB-1 through SBLAB-5). The “beginning depth” is the depth below ground surface, in feet, where sample collection begins and the “ending depth” is the depth below ground surface where sample collection ends.

The samples will be shipped off site by commercial carrier and COC (security) seals will be placed on the sample shipping container to ensure the samples have not been disturbed during transport. Two seals will be placed on the front and two on the back of the cooler, across the closure. The seals will be signed and dated by sampling personnel.

Evidence of collection, shipment, laboratory receipt and laboratory custody until completion of analyses will be documented via a COC record containing the signature of the individuals collecting, shipping and receiving each sample. The COC record must be signed and dated by a member of the sampling team.

The COC will be initiated in the field by the field staff performing sampling and will accompany each set of samples shipped to the laboratory. Each sample will be assigned a unique identification number entered on the COC, with samples grouped for shipment on a common form. Each time responsibility for custody of the samples changes, the receiving and relinquishing custodians will sign the record and denote the date and time. When the samples are shipped to the laboratory by commercial carrier, the COC will be sealed in a watertight bag, placed in the shipping container and the shipping container will be sealed prior to transferring to the carrier. The carrier waybill will serve as an extension of the COC between the final field custodian and receipt in the laboratory.

Upon receipt in the laboratory, a designated individual will open the shipping containers, compare the contents with the COC, and sign and date the record. Any discrepancies will be noted on the COC or the laboratory’s sample receipt form. If discrepancies occur, the samples in question will be segregated from normal sample storage and the field personnel notified for clarification. COC records (including waybills) and sample receipt records will be maintained as part of the project records.

In addition to sample COC documentation, samples will be documented in the field staff notes and on boring logs. Field notes will describe the field events including dates, times, locations, instrument calibrations and communication logs between project management, FHRA staff, the ADEC and field staff. Changes to sampling protocol will be documented in the field book and will be communicated to appropriate FHRA and project personnel, as well as the ADEC. Sketches will be prepared in the field to document soil boring locations, and GPS coordinates of the locations will be obtained upon completion. Boring logs will include soil types, densities, descriptions, anomalies and sample locations and identification numbers.

8. Analytical Methods

SGS Environmental Services, Inc. (SGS) in Anchorage, Alaska, will conduct laboratory analysis. SGS is an ADEC-approved laboratory for contaminated sites analysis. SGS maintains a written QA/QC program that conforms, as a minimum standard, to QA/QC protocol set forth in the USEPA Test Methods for Evaluating Solid Waste, SW-846, November 1986, or any subsequent approved versions of this testing protocol and the ADEC Underground Storage Tanks Procedures Manual (ADEC 2002) for the whole fuels methods.

The laboratory will provide a copy of the QA/QC plan for review, upon request by the ADEC. The laboratory will be certified by the ADEC for analyses performed for this monitoring program, where such certifications exist.

ARCADIS will submit soil samples from each boring to SGS for analysis of whole fuels using the methods identified in the table below.

Analysis	Sample Bottles and Preservative	Lab Method
GRO	One 125 mL wide-mouth amber glass jar (MeOH with surrogate preservative)	Alaska Method AK 101
DRO and RRO	One 125 mL wide-mouth amber glass jar (unpreserved)	Alaska Method AK 102 and 103
SVOCs	One 125mL wide-mouth clear glass jar (unpreserved)	EPA Method SW8270D
VOCs	One 125 mL wide-mouth clear glass jar (MeOH preservative)	EPA Method 8260B
RCRA 8 Metals	One 125 mL wide-mouth clear glass jar (unpreserved)	EPA Method SW6020/7471B
Sulfolane	Three 40 mL volatile organic analysis vials (unpreserved)	EPA Method 8260B

Notes:
mL = milliliter
MeOH = methanol

Laboratory analysis will be clearly requested on the COC. The laboratory report and data package will be requested using the laboratory’s standard data turnaround time (10 to 14 working days for most analyses).

9. Evaluation of Data Quality

QA and QC are important components of an environmental site investigation. QA is the integrated program for measuring the reliability of the data. QC is the routine use of specific procedures so that defined standards of sampling and analysis are met. This QA/QC plan describes specific procedures to be followed so the laboratory data are effective and do not detract from the quality or reliability of the results.

9.1 Data Quality Objectives

The QA objective for measurement data is to ensure that environmental monitoring data are known and of acceptable quality. For analytical data, the objective is to meet acceptable QA standards of sensitivity, precision, accuracy, representativeness, comparability and completeness. These terms are defined below:

- **Analytical sensitivity**. The laboratory objective for sensitivity is to measure a concentration at less than an analyte's cleanup level.

- **Precision** is a measure of mutual agreement among replicate or duplicate measurements of the same analyte. The laboratory objective for precision is to equal or exceed the precision demonstrated for similar samples and will be within the established control limits for the methods published by the USEPA. Field sample precision will be measured as the relative percent difference between the project's primary and duplicate samples.

- **Accuracy** is a measure of bias in a measurement system. Accuracy will be expressed as the percent recovery of an analyte from a surrogate or matrix spike sample, or from a standard reference material. The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for these analytical methods on similar samples and will be within the control limits for the methods established by the laboratory.

- **Representativeness** is a quality characteristic attributable to the type and number of samples to be taken so as to be representative of the environment. Sample locations will be selected in the field to be representative of the water at that sample location.

- **Comparability** is a qualitative parameter expressing the confidence with which one data set can be compared to another. The sampling method employed, methods used to transfer the samples to the analytical laboratory and analytical techniques implemented at the laboratory will be performed in a uniform manner.

- **Completeness** is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. The objective of completeness is to generate an adequate database to successfully achieve the goals of the investigation.

9.2 Reporting

The laboratory will be directed to provide one laboratory report of all data collected during this assessment. The laboratory report will include a case narrative that clearly identifies all QA/QC deviations, and a discussion of any anomalies or deficiencies with the analyses. The laboratory data packet will be reviewed for QA, as described in Section 9.1.

ADEC Data Review Checklists and a report case narrative describing data quality will be completed by ARCADIS and included in the investigation completion reporting.

The laboratory will achieve all stated reporting limits (practical quantitation limits) for the listed analytes. Any non-detect results will be reported with the corresponding detection limit. Reporting non-detects at elevated reporting levels will not be accepted, especially with diluted samples, unless matrix effects can be clearly demonstrated.

9.3 Outliers

An observation that is very different from all other observations in a group of observations is called an outlier. Any outliers reported in the FHRA data will be evaluated for cause and, where possible, corrected. Documentation of the cause of the outlier will be provided prior to correcting or excluding data values from evaluations. If the cause of the outlier cannot be attributed to sampling, laboratory or reporting error, the value will not be excluded from the database.

10. Health and Safety

All personnel conducting soil boring installation and soil sampling at the FHRA NPR will conform to the FHRA's site-specific health and safety policies. ARCADIS sampling personnel will conduct sampling activities in accordance with the ARCADIS Corporate Health and Safety Program. Other site-specific health and safety concerns will be addressed as part of the FHRA safe work practices, including site access, use of vehicles and equipment, and Occupational Safety and Health Administration compliance. FHRA safe work permits are required at all times and must be kept at the site at all times.

11. Completion Reporting

ARCADIS will prepare a report detailing the results of the investigation. The report will generally consist of the field activities, boring installation and backfill details; boring logs; and a summary of the laboratory analytical data. The report will also include an updated CSM for the laboratory area, including the findings of this investigation, and an updated COC list. If constituents are present at concentrations exceeding the applicable soil to groundwater standards, then the current groundwater monitoring program for the NPR will be reviewed to determine if additional analytes should be added to the quarterly program. The completion reporting will be completed within 6 weeks of acceptance of the final analytical data.

12. References

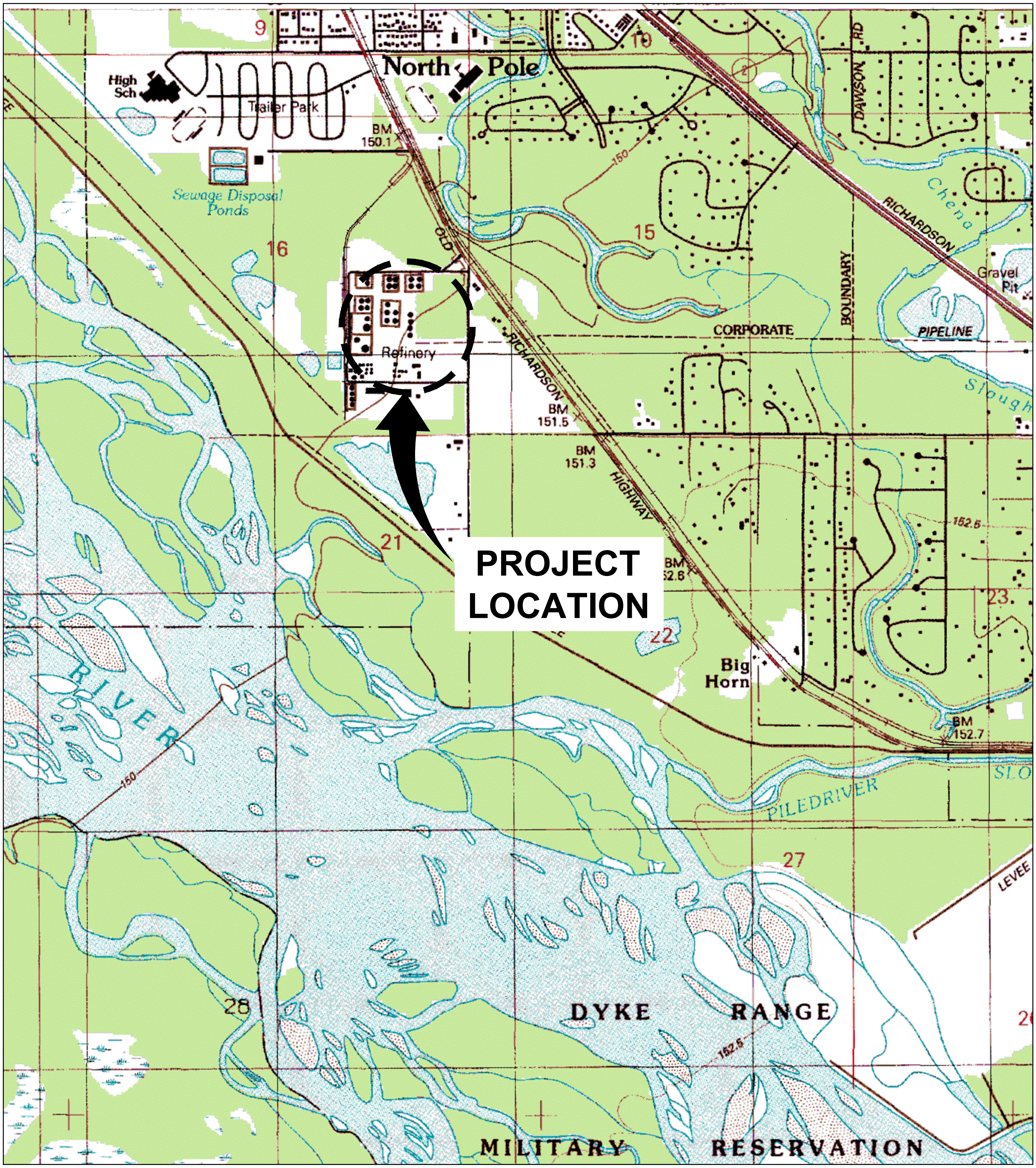
Alaska Department of Environmental Conservation. 2002. Underground Storage Tanks Procedures Manual, Guidance for Treatment of Petroleum-Contaminated Soil and Water and Standard Sampling Procedures. Division of Spill Prevention and Response Contaminated Sites Program. November 7, 2002.

Alaska Department of Environmental Conservation. 2010. Draft Field Sampling Guidance. Division of Spill Prevention and Response Contaminated Sites Program. May 2010.

Barr Engineering Company. 2010. Site Characterization Work Plan, North Pole Refinery, North Pole, Alaska. September 2010.

Flint Hills Resources Alaska, 2010. North Pole Refinery (NPR) Lab Sump Piping Failure Investigation Report. July 2010.

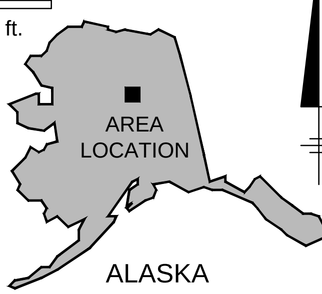
Figures



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., FAIRBANKS (C-1) NW, AK, 1992.

0   2000'   4000'

Approximate Scale: 1 in. = 2000 ft.



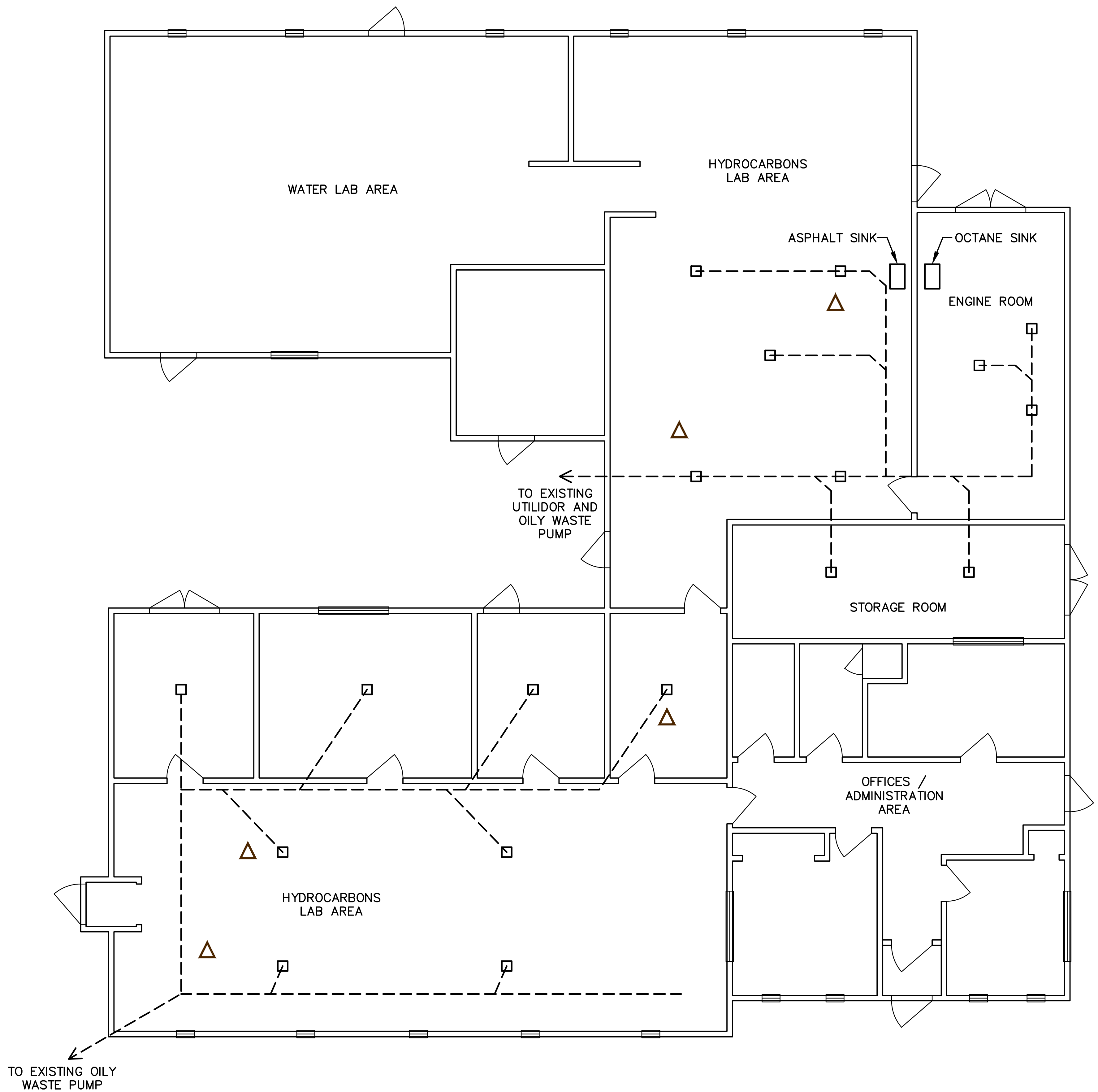
FLINT HILLS RESOURCES
ALASKA, NORTH POLE REFINERY
LABORATORY AREA SUBSURFACE INVESTIGATION WORK PLAN

SITE LOCATION MAP

ARCADIS

FIGURE
1

CITY: SYRACUSE, N.Y.   DIV/GROUP: ENVCAD-141   DB: D.HOWES, R.ALLEN   LD:(Opt)   PIC:(Opt)   PM: R.ANDRESEN   TM:(Opt)   LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0081981\0004\00001\DWG\81981N01.dwg   LAYOUT: 1   SAVED: 1/25/2011 11:05 AM   ACADVER: 18.0S (LMS TECH)   PAGESETUP: ----   PLOTSTYLETABLE: PLTFULL.CTB   PLOTTED: 1/25/2011 11:07 AM   BY: ALLEN, ROYCE
XREFS: IMAGES: 81981X01.tif   PROJECTNAME: ----



LEGEND:

- □ FOOR DRAIN
- △ PROPOSED SOIL BORING LOCATION

NOTES:

1. EXISTING BUILDING DIGITIZED FROM PDF OF DRAWING MADE BY "FLINT HILLS RESOURCES" DATED 4/25/85, NAMED "BUILDINGS 1985 LABORATORY EXPANSION UNDERGROUND PIPING PLAN" D-10-M1000. BUILDING EXTENSION DIGITIZED FROM PDF OF DRAWING MADE BY M-E-B ENGINEERING SERVICES, DATED 6/15/98, NAMED "PIPING PLAN" D-10-M1007,
2. ALL LOCATIONS ARE APPROXIMATE.

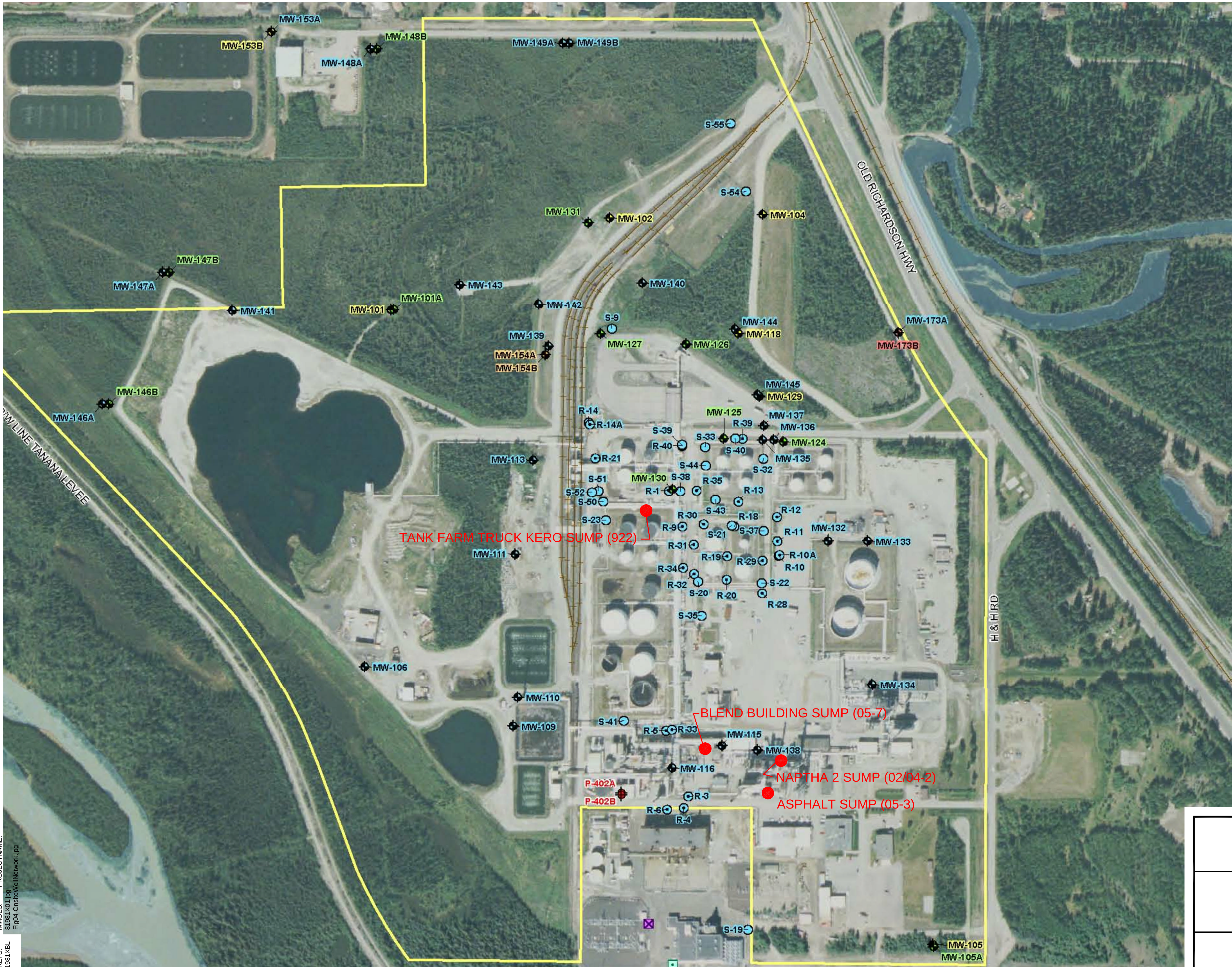
NOT TO SCALE

FLINT HILLS RESOURCES
ALASKA, NORTH POLE REFINERY
LABORATORY AREA SUBSURFACE INVESTIGATION WORK PLAN

SITE PLAN

ARCADIS

FIGURE
2



Production Wells

GVEA Injection Well (Approximate)

GVEA Production Well (Approximate

Monitoring Well

Observation Well

Recovery Well

Well Screen Placement (Screen Top)

Within 10 feet of the water table

10 -25 below the water table

25-60 feet below the water table

60-90 feet below the water table

90-150 feet below the water table

FHRA Property Boundary

SUMP LOCATION

400 200 0 400

Feet

NOTE:

1. FIGURE PROVIDED BY SHANNON & WILSON. ACCURACY OF LOCATIONS AND SCALE UNVERIFIED.

FLINT HILLS RESOURCES
ALASKA, NORTH POLE REFINERY
LABORATORY AREA SUBSURFACE INVESTIGATION WORK PLAN

ONSITE WELL NETWORK

ARCADIS

FIGURE
3

ARCADIS

Appendix A

Project Personnel Resumes

Education
BA, Geology/Environmental Sciences, Washington and Lee University, Lexington, VA, 1994

Years of Experience
Total - 17
With ARCADIS - 10

Professional Registrations
Professional Geologist, GA, since 2000
Professional Geologist, NC, since 2001
Professional Geologist, TN, since 2001
Professional Geologist, WA

Rebecca K. Andresen, PG

Senior Geologist

Ms. Andresen is an experienced geologist with 17 years of experience in environmental consulting. Her experience includes: performing various portfolio and project management duties; managing due diligence activities; preparing Risk-Based Corrective Action Plans; conducting Phase I and II environmental site assessments; conducting intrinsic bioremediation studies, and preparing feasibility studies.

Project Experience

Site Assessment and Remedial Design
Chevron Corporation, Grays Chap
B0043970.0000
Project Manager for site assessment at a former retail station. Based on the assessment, carbon filtration units were installed on potable wells located at nearby homes and an elementary school. Negotiations are ongoing to hook local homes into a municipal supply. The project also involves evaluation, pilot testing, and design of a remedy for petroleum impact at the site. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, negotiations with the State regulatory agency, and interface with key stakeholders.

Site Assessment, Groundwater Modeling and Remedial Design Evaluation
Chevron Corporation
B0044316.0000
Project Manager for a multiple-RP former bulk fuel terminal. The project involved evaluation and groundwater modeling to support a design for phytoremediation to address dissolved-phase ammonia impact at the site. Assessment activities also included delineation of areas impacted with high levels of lead and petroleum constituents, and location of approximately one mile of buried pipeline on the site. Also managed site grading activities in preparation for the phytoremediation system. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Air Sparge and Soil Vapor Extraction (AS/SVE) System Upgrade
Chevron Corporation, Anchorage, AK
B0044663.0000
Project Manager for a portfolio of former retail petroleum sites. All of the sites are in the assessment and remedial design phase, with a minimum of two system installations planned per year. Five of the sites have operating AS/SVE systems, and one site has a dual-phase extraction

system. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Site Characterization and Groundwater Monitoring
Chevron Corporation, Fairbanks, AK
B0044674.0000
Project Manager for a portfolio of former retail petroleum sites. All of the sites are in the assessment and remedial design phase, with a minimum of two system installations planned per year. Five of the sites have operating AS/SVE systems, and one site has a dual-phase extraction system. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Assessment and Remediation Project
Chevron Corporation, Fairbanks, AK
B0044676.0000
Project Manager for a portfolio of former bulk petroleum sites. All of the sites are in the assessment and remedial design phase, and most involve multiple RPs. Work at one of the sites is conducted under an EPA Consent Order under CERCLA. Planned remediation tasks include excavation and soil treatment with a mobile soil burning unit. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Assessment and Remediation Project
Chevron Corporation, Anchroage, AK
B0045334.0000
Project Manager for a portfolio of former retail petroleum sites. All of the sites are in the assessment and remedial design phase, with a minimum of two system installations planned per year. Five of the sites have operating AS/SVE systems, and one site has a dual-phase extraction system. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Remediation Project
Chevron Corporation
B0045362.0000
Project Manager for a former bulk terminal on the waterfront. The project is conducted under an agreed order with the State of Washington, and include an estimated 64,000 ton excavation, on-site treatment of groundwater, 350-feet of sediment removal along a creek bed, installation of monitoring wells to determine flow paths, groundwater modeling, and likely design and installation of a groundwater remediation system. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, negotiations with the State regulatory agency, and interface with key stakeholders.

211815 SITE
Chevron Corporation, Fairbanks, AK
B0045505.0000
Project Manager for a portfolio of former bulk petroleum sites. All of the sites are in the assessment and remedial design phase, and most involve multiple RPs. Work at one of the sites is conducted under an EPA Consent Order under CERCLA. Planned remediation tasks include excavation and soil treatment with a mobile soil burning unit. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

90430 SITE
Chevron Corporation, Anchorage, AK
B0045509.0000
Project Manager for a portfolio of former retail petroleum sites. All of the sites are in the assessment and remedial design phase, with a minimum of two system installations planned per year. Five of the sites have operating AS/SVE systems, and one site has a dual-phase extraction system. Management responsibilities include planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Management Transfer Project
Chevron Corporation, Atlanta
B0060501.0000
Project Manager for a portfolio of 49 sites. The portfolio management involved set, lump-sum costs to take former retail sites through regulatory closure. The sites ranged from remedial design phase through monitoring only. Successfully closed all but 9 of the sites during three years of management, at an average profit of approximately 25%. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Management Transfer Project
Chevron Corporation, Knoxville
B0060862.0000
Project Manager for a portfolio of 64 sites in the southeast. The portfolio management involved set, lump-sum costs to take former retail sites through regulatory closure. The sites ranged from remedial design phase through monitoring only. Average profit of the portfolio was approximately 25%. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Groundwater Monitoring, LNAPL Recovery, Strategic Planning (41884, 42527, 42679, 43138, 43744)

Confidential Client, Knoxville, Tennessee

2005, Project Cost: $115,000

Project manager responsible for planning and oversight of semi-annual groundwater monitoring and installation and operation of a passive LNAPL recovery devise. Project responsibilities also included strategic planning for additional assessment and remediation; the site layout makes additional well placement extremely difficult, and site groundwater fluctuates up to 30-feet per well between karst terrain and the soil overburden. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Site Assessment and Monitoring (41836, 41883, 41885, 42115, 42133, 42157)

Confidential Client, Tennessee

2002, Project Cost: $100,000

Project manager responsible for planning and conducting site assessment and/or groundwater monitoring at active and former retail gasoline stations. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Site Assessment and Monitoring (41567, 41897, 41932, 42107, 42110)

Confidential Client, Georgia

2002, Project Cost: $85,000

Project manager responsible for planning and conducting site assessment and/or groundwater monitoring at active and former retail gasoline stations. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Site Assessments (36931, 36958)

Confidential Client, Palatine, Illinois/Raleigh,North Carolina

2003, Project Cost: $120,000

Managed and/or conducted the field work for site assessments of former fueling stations at active stations. Field work included oversight of bedrock monitoring wells.

Site Assessments (42471, 43134, 43496, 44323)

Confidential Client, North Carolina

2005, Project Cost: $270,000

Project manager for comprehensive site assessments at two former retail gasoline stations. One of the sites was in use as residence, so the assessment also included the installation and sampling of vapor monitoring points. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Monitoring Well Installation (40129)

Confidential Client, Georgia

2002, Project Cost: $175,000

Field supervisor for installation of bedrock monitoring wells at a manufacturing facility.

Quarterly Groundwater Monitoring (20484, 40128, 40472, 40483)

Confidential Client, Georgia

2005, Project Cost: $1,000,000

Managed a quarterly groundwater gauging and ultra-low flow sampling program at a former manufacturing facility. The program involved sampling up to 100 wells per event, and involved staff coordination for the duration of the five-week events.

Exposure Assessments (42464, 42468, 42496)

Confidential Client, Tennessee

2002, Project Cost: $30,000

Prepared modified risk assessments for three former retail gasoline sites. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Site Assessment and Remedial Design (42454, 43138, 43382)

Confidential Client, Grays Chapel, North Carolina

Ongoing, Project Cost: $250,000

Project manager for site assessment at a former retail station. Based on the assessment, carbon filtration units were installed on potable wells located at nearby homes and an elementary school. Negotiations are ongoing to hook local homes into a municipal supply. The project also involves evaluation, pilot testing, and design of a remedy for petroleum impact at the site. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, negotiations with the State regulatory agency, and interface with key stakeholders.

Site Assessment, Groundwater Modeling, and Remedial Design Evaluation (43705, 43744)

Confidential Client, Savannah, Georgia

2005, Project Cost: $70,000

Project manager for a multiple-RP former bulk fuel terminal. The project involved evaluation and groundwater modeling to support a design for phytoremediation to address dissolved-phase ammonia impact at the site. Assessment activities also included delineation of areas impacted with high levels of lead and petroleum constituents, and location of approximately one mile of buried pipeline on the site. Also managed site grading activities in preparation for the phytoremediation system. Management responsibilities included planning, budgeting, scheduling, and reporting, as well as primary client contact, and negotiations with the State regulatory agency.

Feasibility Study

Confidential Client, Nationwide

1999, Project Cost: $40,000

Managed the preparation of a feasibility study for the financial and logistical advantages for the installation of private water sources for process and/or potable use (versus the available municipal supply) at 16 national snack-food plants. The study considered the potential water supply, potential treatment required, permitting requirements, and expense and capital costs amortized for 10 years. Based on the study, the national manufacturer began initial exploration activities at eight of the plants.

Work Plan Creation

Confidential Client, Georgia

1999, Project Cost: $100,000

Created work plans for multiple sites impacted with adsorbed- and dissolved-phase contaminants including petroleum hydrocarbon compounds and chlorinated solvents, for major oil companies and a wallboard manufacturer.

Phase I and II Site Assessment

Confidential Client, Georgia

1999, Project Cost: $100,000

Conducted assessment work at wall-board manufacturing plants.

Phase I and II Site Assessment

North Carolina

1994, Project Cost: $75,000

Conducted assessment work at an air-conditioner manufacturing plant.

Phase I and II Site Assessment

Confidential Client, Georgia

1998, Project Cost: $40,000

Conducted assessment work for a national manufacturer at a compressor reconditioning plant.

Phase I and II Site Assessment

Confidential Client, Georgia/Alabama

1997, Project Cost: $50,000

Conducted assessment work at paper plants.

Hydrogeologic Investigations and Remedial Activities

Confidential Client, Georgia/Tennessee/Alabama

2000, Project Cost: $1,000,000

Project manager for petroleum-related hydrogeologic investigations and remedial activities for an international petroleum company. Responsibilities include preparing the project work scope, budgeting, scheduling, conducting negotiations with state and local authorities, and reviewing final documents prepared to satisfy client and regulatory requirements.

Active Remediation Systems Design

Confidential Client, Georgia/Alabama

2001, Project Cost: $300,000

Project manager for the design of active remediation systems at retail and bulk petroleum distribution facilities for major oil companies. The remediation systems were installed to address nonaqueous phase liquid (NAPL) and dissolved-phase plumes.

Acquisition of Retail Petroleum Centers

Confidential Client, Missouri

2000, Project Cost: $30,000

Developed the work scope and managed the due diligence process for the acquisition of multiple retail petroleum centers for a regional petroleum company. Completed the Phase I and Phase II assessment work under budget and within the 60-day timeframe.

Acquisition of Retail Petroleum Centers

Confidential Client, Tennessee

2000, Project Cost: $75,000

Developed the work scope and managed the due diligence process for the acquisition of multiple retail petroleum centers for a regional petroleum company. Completed the Phase I and Phase II assessment work under budget and within the 60-day timeframe.

Selected Publications

Parkins, R.K. 1994. The Use of Magnetic Intensity in Mapping Greenstone Contacts in the Catoctin Formation, Buena Vista Quadrangle,Virginia. Seventh Keck Research Symposium in Geology, Keck Geology Consortium, p. 135-138.

Presentations

Parkins, R.K. 1996. "The Use of AT-123D to Determine Risk of Exposure." Presented at the Eighth Annual Alabama Department of Environmental Management UST Assessment and Remediation Conference, October, Montgomery, Alabama.

Education
MS, Civil Engineering, University of Minnesota, Minneapolis, MN, 2005
BA, Physics, Gustavus Adolphus College, St. Peter, MN, 2002

Years of Experience
Total - 5
With ARCADIS - 3

Professional Registrations
Engineer In Training,

Andrew W. Ohrt, EIT

Staff Engineer

Mr. Ohrt has four years of professional experience in the environmental consulting industry and has been with ARCADIS US, Inc., since January 2008. Prior to joining ARCADIS Andrew was employed by Delta Consultants, working as a Project Engineer in Washington and California. Previous work includes soil and groundwater investigations, remediation system design, pilot testing, installation, and operation and maintenance. I have also prepared and/or reviewed work plans, system startup reports, operations and maintenance reports, quarterly monitoring reports, and site conceptual models. He has worked in Washington, California, and Alaska performing the aforementioned activities. Mr. Ohrt is currently responsible for providing environmental engineering support and expertise to remediation projects throughout Alaska.

Project Experience

Project Planning and Oversight
Alaska
As a Staff Engineer at Arcadis responsible for execution and oversight of field work from the planning stages to completion. Tasks include managing field staff, communicating with stakeholders and regulators, permit acquisition and compliance, and subcontractor management. Also responsible for technical and health and safety oversight of field activities including operation and maintenance (O&M) activities, remedial implementation and remediation system upgrade activities.

Former Unocal Edmonds Terminal
Edmonds, Washington
As a Staff Engineer at Arcadis in Seattle conducted contracting, data management, and report preparation activities to assist the project manager with regulatory compliance and permit acquisition. Also conducted data management of submittals to the Washington State Department of Ecology environmental database and communicated with Department of Ecology representatives to ensure data completeness and usability.

Monitored Natural Attenuation
Alaska
Designed and implemented monitored natural attenuation studies at multiple sites with residual hydrocarbon impacts. Completed summary reports establishing a technical basis for natural attenuation at the sites based on data collected and a review of historical studies of natural attenuation in cold regions.

Air/Ozone Sparge and Soil Vapor Extraction Remediation System – Installation and Operations and Maintenance

Washington

Conducted installation of an air/ozone sparge and soil vapor extraction (SVE) remediation system to treat benzene and petroleum hydrocarbons in groundwater and soil at an active petroleum pipeline facility. Additional responsibilities included system O&M, system monitoring, and optimization of the ozone generator and other remediation equipment.

AS/SVE Remediation System Expansion

Washington

Conducted field oversight during expansion of an AS/SVE system at an active petroleum pipeline facility. Responsibilities included system design, subcontractor management, health and safety oversight, and subsequent system optimization.

Groundwater Monitoring and Remedial Implementation

Washington and Alaska

Conduct oversight of groundwater monitoring activities at former bulk plants and active petroleum pipeline facilities in Washington and Alaska. Manage stakeholders as well as coordinate field staff for periodic monitoring. Provide oversight and O&M expertise to remedial systems located at select sites. Remediation technologies included air sparging, ozone sparging, SVE, sulfate amendment and multi-phase extraction (MPE). Additional tasks include scheduling of field work, water quality analysis, field and system parameter assessment, and subsequent report preparation oversight.

Multi-phase Extraction Program

Washington and Alaska

Coordinate field staff and stakeholders for periodic MPE events in Washington and Alaska. Conducted LNAPL recovery on the monitoring wells and interceptor trenches located in the highway. Conducted health and safety oversight of high traffic lane closures and technical oversight of liquid and vapor flow measurement and mass recovery calculations. Also applied MPE to various other sites in Washington and Alaska including active petroleum pipeline facilities.

Site Assessment

Washington, California, and Alaska

Performed oversight in the advancement of soil and groundwater assessment borings by direct-push and hollow stem auger drill rigs. Drilling projects included the collection of soil samples, lithologic logging, monitoring well installation, well development and groundwater sampling. Subsequent tasks included data analysis, report preparation, and contact with regulatory agencies to obtain proper permits and registrations.

Selected Publications

Ohrt, A.W., P.D. Capel, and R.W. Black. (2006). Concentrations of Current-Use Agricultural Pesticides in the Air, Yakima County, Washington. Proceedings of the Workshop on Agricultural Air Quality: State of the Science. Department of Communication Studies. Raleigh, NC.

Capel, P. D. and A. W. Ohrt. (2006). Modeling Dry Deposition of Atmospheric Pesticides to an Agricultural Watershed in Washington. (2006). Proceedings of the American Chemical Society 232nd National Meeting and Exposition, Division of Agrochemicals. USDA-ARS. Beltsville, MD.

ARCADIS
Infrastructure · Water · Environment · Buildings

Education
BA Earth and Space Science, University of Washington, 2005

Years of Experience
Total - 5
With ARCADIS – 4

Professional Qualifications
First-Aid Certified
CPR Certified
Excavation and Shoring Competent Person Trained
Confined-Space Entry Competent Person Trained
Certified Erosion Control and Sedimentation Lead (WA State)
Loss Prevention System Behavioral Based Safety Program Trained

David Rasar

Scientist II

David Rasar has 5 years experience working on petroleum remediation projects. David specializes in field work, subsurface investigations, groundwater sampling, data collection and field supervisory positions, including small and large scale excavation projects. David also performs report writing, data review and project management support. Most recently, David has been acting as a Task manager on a portfolio of 25 retail petroleum sites.

Category of Experience

BP Tranche II Portfolio (GP09BPNA.WA)
Washington State
Ongoing GRiP Portfolio
Task Manager performing field work, sampling, reporting, planning and coordination activities for approximately 25 retail gasoline sites in western Washington. Responsibilities include training junior staff, field work oversight, report writing and project management support. Field work includes, soil sampling, groundwater sampling, subsurface investigation, pilot testing, hydraulic conductivity testing, system installation, excavation and subsurface chemical injections.

Former Unocal Edmonds Terminal (B0045362)
Edmonds, Washington
2007 to Present, ongoing remediation
Performed field work during Interim Action excavation activities from July 2007 to June 2009. Responsibilities included construction oversight, soil sample collection, manual product recovery, stockpile management, onsite water treatment system operation and sampling, contractor oversight and health and safety oversight. Also coordinate and supervise field crews during quarterly groundwater sampling events, manage storm detention basins and perform sampling and reporting for discharge permits. Completed reporting requirements for Interim Action Cleanup activities, groundwater monitoring and discharge permits.

Former Unocal Seattle Terminal (B0045363)
Seattle, Washington
2007 to Present, ongoing remediation
Perform groundwater sampling, subsurface investigation, soil sampling and various field work activities. Assist in reporting and responsible for King County Industrial Discharge permit reporting and renewal. Assist with implementation, analysis and reporting for site-wide hydraulic influence and tidal study.

Willbridge Terminal (B0045452)

Portland, Oregon

July, 2009.

Completed field supervisory role for construction project including, excavation, shoring, confined space entry, underground utility replacement activities, pump installation, water treatment and cure-in-place pipe liner installation. Supervised all site conducted onsite in active refinery terminal, assured project completion on –time and on-budget. Worked closely with multiple contractors simultaneously to ensure project plans were executed and work was conducted safely. Conducted all site safety meetings including orientation training, ensured all safety practices implemented onsite. Assisted project management with budgeting, scheduling, reporting, and milestones.

Chevron Alaska (B0045497-B0045512)

State of Alaska

2007 to present, ongoing portfolio

Performs field work, sampling, reporting, planning and coordination activities for Alaska portfolio of 18 retail and bulk fuel petroleum sites. Responsibilities include training junior staff, field work oversight, report writing and project management support. Field work includes subsurface investigations, groundwater sampling, remediation system installation and upgrading and excavation.

ARCADIS

Education
Bachelor of Science Geosciences, University of Arizona, Tucson, Arizona 2007

Years of Experience
Total – 3.5
With ARCADIS – 3.5

Professional Registrations
Geologist in Training, WA

Professional Qualifications
ASBOG – Fundamentals of Geology
HAZWOPER
OSHA Site Supervisor

Michael L. Strickler, G.I.T.

Geologist II

Mr. Strickler has 3.5 years of experience in the environmental consulting industry. His experience is focused in the areas of environmental site investigations; remediation monitoring; soil gas vapor intrusion assessment and mitigation; hydrogeologic modeling and data quality assurance.

Selected Experience

Remediation and Monitoring at Former Service Stations
Chevron Environmental Management Company
Anchorage, Fairbanks, Kenai, Delta Junction (ALASKA)
2007-Present

Prepared site assessment work plans, groundwater monitoring reports, site assessment reports and proposals for over 20 former petroleum service stations and former bulk fueling terminals in the State of Alaska. Served as the site supervising geologist on numerous site assessment activities and environmental drilling projects within the State of Alaska. Experience also includes regulatory compliance with the Alaska Department of Environmental Conservation and data quality assurance.

Soil Gas Vapor Intrusion Assessment
Chevron Environmental Management Company, Flint Hills Resources, Georgia-Pacific, ARCO/BP, ConocoPhillips
Anchorage, Fairbanks (ALASKA); Colma, South San Francisco, Fort Bragg, Los Angeles, Anaheim, Sacramento, Turlock (CALIFORNIA); Portland (OREGON); San Marcos (GUATEMALA, CENTRAL AMERICA)
2008-Present

Assisted in the project scoping, planning, budgeting, sampling design, field work and data analysis of various soil gas vapor intrusion assessments. Worked on sites including the Chevron Products terminal (Port of Anchorage, Alaska), Flint Hills Resources terminal (Port of Anchorage, Alaska), former Chevron, Texaco and Unocal bulk fueling terminals (Fairbanks, Alaska), multiple former Chevron service stations (Colma, South San Francisco, Anaheim, Sacramento, California), former Chevron LA Additives Facility (Los Angeles, California), former Georgia-Pacific Fort Bragg Paper Mill (Fort Bragg, CA) and an active service station in San

Marcos (Guatemala, Central America). Expertise includes the design and implementation of sub-slab soil gas sampling projects as well as permanent, multi-level subsurface soil gas probes. Specializes in the analysis of contaminant vapor data, vapor biodegradation and vapor intrusion mitigation.

Site Assessment and Remediation Monitoring
Chevron Environmental Management Company
Seattle, Edmonds (WASHINGTON)
2008-Present

The Seattle Olympic Sculpture Park (OSP), owned and operated by the Seattle Art Museum, was a former Unocal bulk fueling terminal. Involved with the remediation monitoring of approximately 15 groundwater compliance monitoring wells in addition to assistance with regulatory compliance. Provided technical assistance with remediation strategies for various carcinogenic polynuclear aromatic hydrocarbons (cPAHs) still present in groundwater at the OSP. Provided support and technical assistance with light non-aqueous phase liquid (LNAPL) characterization and remediation with various technologies such as mobile multi-phase extraction (MPE) and surfactant injection.

The former Unocal Edmonds bulk fueling facility in Edmonds, Washington was excavated in the fall and winter of 2007 and summer of 2008 by ARCADIS. Served as a site geologist for environmental assessment drilling and provided technical assistance with non-hazardous and hazardous waste management.

Surfactant, Sulfate and Acetic Acid Injections
Chevron Environmental Management Company, Hexion Specialty Chemicals
Anchorage (ALASKA), Seattle (WASHINGTON), Vancouver (BRITISH COLUMBIA, CANADA)
2010-Present

Served as a site supervising geologist during surfactant injections at the Former Unocal Seattle Marketing Terminal (Seattle, Washington) for treatment and extraction of non-mobile LNAPL, surfactant injection and extraction at a former bulk petroleum facility (Anchorage, Alaska), sulfate injections at a former service station (Anchorage, Alaska), and acetic acid injections at a former chemical plant in Vancouver (British Columbia, Canada). Also assisted with subcontractor oversight and technical design of pilot test procedures.

Injectability Testing and Air Sparge Testing
Hexion Specialty Chemicals
Vancouver (BRITISH COLUMBIA, CANADA)
2010-Present

Served as a site supervising geologist for injectability testing and air sparge testing during a pilot test at a former chemical plant in Vancouver (British Columbia, Canada). Assisted with compliance associated with the Province of British Columbia Ministry of Environment (MOE).

Contaminant and Hydrogeologic Modeling
Chevron Environmental Management Company
Anchorage, Fairbanks, Delta Junction (ALASKA)
2007-Present

Provided technical assistance with delineation of contaminant plumes in soil, groundwater and contaminants in the vapor phase. Through the use of computer modeling and mathematical calculation, assisted in additional assessment determination as well as extents of contamination. The models developed have been used in remediation decisions for various types of engineering applications such as air sparge and soil vapor extraction system design.

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Appendix B

Chemicals of Concern in Laboratory Sump

Chemicals in Lab Sump

Hydrocarbon Reagents	
1,2-dichloroethane-d4	Isopropanol
1,4-dichlorobenzene-d4	Isopropyl benzene
2-Propanol	Methanol
4-bromoflourobenzene	methyl ethyl ketone
5-choloro-tricholoromethyl pyridine	methyl isobutyl ketone
80% iso-oct/20% n heptanes	Mineral Oil
acetone	MTBE
acetonitrile	naphthalene
Benzene	n-butanol
BOD Nutrient buffer	n-butyl benzene
chlorobenzene-d5	n-decane
cyclohexane	n-heptane
cyclopentane	n-nonane
ETBE	neo hexane
ethanol	oil & grease standard
ethylbenzene	pentane
flourobenzene	Petroleum Ether
Heptanes	pH buffer kit
hexadecane	potassium hydroxide
hexane	propylene glycol
hydranal coulomat*	silicon bath oil
iso amyl alcohol	silver nitrate
isobutyl alcohol	sulfolane
Iso-octane	synthetic pump oil
Other Reagents	
1,10-phenanthroline-p-toluene sulfonic acid salt	polyvinyl alcohol
12-hydroxystearic acid	potassium bi-iodate
2-chloro-6-(trichloromethyl)pyridine	potassium chloride solution
4,5-dihydroxy-2,7-naphthalenedisulfonic acid, disodium salt	potassium dichromate
4-aminoantipyine	potassium ferricyanide
4-aminoantipyrine phosphate	potassium hydrogen phthalate
acetic acid	potassium hydroxide
acetonitrile	potassium iodide
alkali iodine azide solution	potassium nitrate
aminomethylpropanol	potassium nitrite
Ammonium chloride	potassium oxalate
Ammonium hydroxide	potassium permanganate
Aniline	potassium phosphate, dibasic
ascorbic acid	potassium phosphate, monobasic
asino ethylpropanol	potassium pyrosulfate

Chemicals in Lab Sump	
Barium Chloride	potassium sodium tartrate
boric acid	potassium sulfate
Bromine	proprionic acid
Buffer solution pH10	SALT FOR DEICING AND WATER SOFTENERS
Buffer solution pH4	silica gel
Buffer solution pH7	silver chloride
cadmium	silver nitrate
calcium chloride	silver sulfate
calmagite	sodium acetate
Carbon Disulfide	sodium azide
CDTA trisodium salt	sodium bicarbonate
chloroform	sodium borate
chromium trioxide	sodium carbonate
citric acid	sodium chloride
Cupric Carbonate, basic	sodium gluconate
Cupric Nitrate	sodium hydrosulfite
dextrose	sodium hydroxide
diethanolamine hydrochloride	sodium iodide
DIETHYLENE GLYCOL MONOMETHYL ETHER (FSII)	sodium metabisulfite
dilute hydrochloric acid	sodium molybdate
Dilute Nitric Acid	sodium phosphate
dilute sulfuric acid	sodium Plumbite
diphenylcarbazone indicator	sodium sulfanilate
EDTA	sodium sulfate
ferrous ammonium sulfate	sodium sulfide
ferrous chloride	sodium sulfite
ferrous sulfate	sodium tartrate
formaldehyde	sodium thiosulfate
gentisic acid	Stadis 450
Glutamic Acid	starch indicator
glycerine	sulfanilic acid
hydrogen peroxide	sulfur
iodine	talc
iodine monochloride	tartaric acid
lithium chloride	trichoro-triflouro ethane
lithium hydroxide	various mineral salts
lithium nitrate	t-amyl alcohol
magnesium sulfate	tetrahydronaphthalene
Manganese Nitrate	tetramethylbenzenes
mercuric iodide	Toluene
Mercuric Nitrate	Toluene-d8
mercuric sulfate	trichloroethylene (slight possible)

Chemicals in Lab Sump	
METHYL CARBITOL SOLVENT (FSII)	trimethylbenzenes
naphtholbenzein	vacuum pump oil
phenol	Viscosity bath oil
phenolphthalein	water standard
phosphate buffer solution	xylenes
phosphoric acid	* (30-60% methanol,10-20% 1-pentanol, 5-15% imadazole, 5-25% dodecyldimethylamine)

Hydrocarbon Samples	
ARC	HVY Kero
Asphalt	Incoming Crude
ASPHALT DEFOAMER	JP-4
BRT bottoms	JP-8
BRT feed	Kero raffinate
BRT ovhd	Kero recycle
Combined Return crude	LAGO
cooling kero	LSR
COREXIT 307 CORROSION INHIBITOR	LT Kero
CU1 stabilizer	LUBRIZOL 8195 GASOLINE ADDITIVE
Deprop bottoms	MDEA
Deprop feed	MONOETHANOL AMINE (MEA)
Desalted Crude	MORLIFE 5000 ASPHALT ADDITIVE
ETHYL ANTIOXIDANT 733 MDA 80	N Kero
ETHYL ANTIOXIDANT 733 PDA (D) 25	Naphtha
F-76	Naphtha raffinate
FHR Return Crude	Naphtha recycle
Full Kero	propylene glycol
Gasoline (unleaded)	S Kero,
HAGO	sulfolane
HITECH 6423 FUEL ADDITIVE	VGO
HITECH 6531 FUEL ADDITIVE	

Waters - samples & other	
Desalter Water	Effluent wastewater
Crude OVHD water	Influent wastewater
C1 Stabilizer ovhd water	Gravel pit water
Deprop ovhd water	Gallery Pond water
Vacuum ovhd water	Fire water
BRT ovhd water	Cooling water for Octane Engines
Recovery ovhd water	Ice machine water
Benzene stripper	HVAC condensate
Boiler water	Deionizer condensate
Kero stripper ovhd water	Cooling water for Bomb Calorimeter

Chemicals in Lab Sump	
Cooling water for boiler	
NALCO Chemicals	
NALclean 8940	Nalco EC 5816A
NALclean 8960	Nalco EC 5828A
Nalco 5376	Nalco EC 5830A
Nalco 5403	Nalco EC2043a
Nalco 5541	Nalco EC5345A
Nalco 5541	Nalco EC5370A
Nalco 5602	Nalco EC5407A
Nalco 7320	Nalco SO771 indicator
Nalco 8735	Nalco SO771 N-2 Titrant
Nalco EC 5419A	Nalco SO780MQT-1
Detergents & cleaners	
409	Janitorial chemicals
A-33 Dry respirator cleaner	Joy
alcojet	neodisher A8
alcotabs	neodisher EM
citrus degreaser	neodisher N
Clorox	neodisher Z
Contrad 70	RBS solution
Contrex	Windex

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Appendix C

Human Health Conceptual Site Model – On-Site

HUMAN HEALTH CONCEPTUAL SITE MODEL

Site: FHR North Pole Refinery - Off-Site CSM Only

Completed By: R. Andresen

Date Completed: May 20, 2010

Follow the directions below. <u>Do not</u> consider engineering or land use controls when describing pathways.

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow <u>and</u> check possible transport mechanisms. Briefly list other mechanisms or reference the report for details.*

(3) *Check exposure media identified in (2).*

(4) *Check exposure pathways that are complete or need further evaluation. <u>The pathways identified must agree with Sections 2 and 3 of the CSM Scoping Form</u>.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, or "C/F" for both current and future receptors.*

Media / Transport Mechanisms

☐ Surface Soil (0-2 ft bgs)
- Direct release to surface soil — *check soil*
- ☐ Migration or leaching to subsurface — *check soil*
- ☐ Migration or leaching to groundwater — *check groundwater*
- ☐ Volatilization — *check air*
- ☐ Runoff or erosion — *check surface water*
- ☐ Uptake by plants or animals — *check biota*
- ☐ Other (*list*):

☐ Subsurface Soil (2-15 ft bgs)
- Direct release to subsurface soil — *check soil*
- ☐ *Migration to groundwater* — *check groundwater*
- ☐ *Volatilization* — *check air*
- ☐ *Other (list):*

☑ Ground-water
- Direct release to groundwater — *check groundwater*
- ☐ *Volatilization* — *check air*
- ☑ *Flow to surface water body* — *check surface water*
- ☑ *Flow to sediment* — *check sediment*
- ☑ *Uptake by plants or animals* — *check biota*
- ☐ *Other (list):*

☑ Surface Water
- Direct release to surface water — *check surface water*
- ☐ *Volatilization* — *check air*
- ☑ *Sedimentation* — *check sediment*
- ☑ *Uptake by plants or animals* — *check biota*
- ☐ *Other (list):*

☑ Sediment
- Direct release to sediment — *check sediment*
- ☑ *Resuspension, runoff, or erosion* — *check surface water*
- ☑ *Uptake by plants or animals* — *check biota*
- ☐ *Other (list):*

Exposure Media / Exposure Pathways / Current & Future Receptors

Exposure Media	Exposure Pathways	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☐ soil	☐ Incidental Soil Ingestion							
	☐ Dermal Absorption of Contaminants from Soil							
☑ groundwater	☑ Ingestion of Groundwater	C/F	C/F	C/F	C/F			
	☐ Dermal Absorption of Contaminants in Groundwater							
	☐ Inhalation of Volatile Compounds in Tap Water							
☐ air	☐ Inhalation of Outdoor Air							
	☐ Inhalation of Indoor Air							
	☐ Inhalation of Fugitive Dust							
☑ surface water	☑ Ingestion of Surface Water			C/F				
	☐ Dermal Absorption of Contaminants in Surface Water							
	☐ Inhalation of Volatile Compounds in Tap Water							
☑ sediment	☑ Direct Contact with Sediment			C/F				
☑ biota	☑ Ingestion of Wild Foods	C/F		C/F				

HUMAN HEALTH CONCEPTUAL SITE MODEL

Site: FHR North Pole Refinery - Off-Site CSM Only

Completed By: R. Andresen

Date Completed: May 20, 2010

Follow the directions below. <u>Do not</u> consider engineering or land use controls when describing pathways.

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow <u>and</u> check possible transport mechanisms. Briefly list other mechanisms or reference the report for details.*

(3) *Check exposure media identified in (2).*

(4) *Check exposure pathways that are complete or need further evaluation. <u>The pathways identified must agree with Sections 2 and 3 of the CSM Scoping Form</u>.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, or "C/F" for both current and future receptors.*

Media / Transport Mechanisms

Surface Soil (0-2 ft bgs) [ ]
- Direct release to surface soil — *check soil*
- [ ] Migration or leaching to subsurface — *check soil*
- [ ] Migration or leaching to groundwater — *check groundwater*
- [ ] Volatilization — *check air*
- [ ] Runoff or erosion — *check surface water*
- [ ] Uptake by plants or animals — *check biota*
- [ ] Other (*list*):

Subsurface Soil (2-15 ft bgs) [ ]
- Direct release to subsurface soil — *check soil*
- [ ] *Migration to groundwater* — *check groundwater*
- [ ] *Volatilization* — *check air*
- [ ] *Other (list):*

Ground-water [x]
- Direct release to groundwater — *check groundwater*
- [ ] *Volatilization* — *check air*
- [x] *Flow to surface water body* — *check surface water*
- [x] *Flow to sediment* — *check sediment*
- [x] *Uptake by plants or animals* — *check biota*
- [ ] *Other (list):*

Surface Water [x]
- Direct release to surface water — *check surface water*
- [ ] *Volatilization* — *check air*
- [x] *Sedimentation* — *check sediment*
- [x] *Uptake by plants or animals* — *check biota*
- [ ] *Other (list):*

Sediment [x]
- Direct release to sediment — *check sediment*
- [x] *Resuspension, runoff, or erosion* — *check surface water*
- [x] *Uptake by plants or animals* — *check biota*
- [ ] *Other (list):*

Exposure Media / Exposure Pathways / Current & Future Receptors

Exposure Media	Exposure Pathways	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
[ ] soil	[ ] Incidental Soil Ingestion							
	[ ] Dermal Absorption of Contaminants from Soil							
[x] groundwater	[x] Ingestion of Groundwater	C/F	C/F	C/F	C/F			
	[ ] Dermal Absorption of Contaminants in Groundwater							
	[ ] Inhalation of Volatile Compounds in Tap Water							
[ ] air	[ ] Inhalation of Outdoor Air							
	[ ] Inhalation of Indoor Air							
	[ ] Inhalation of Fugitive Dust							
[x] surface water	[x] Ingestion of Surface Water			C/F				
	[ ] Dermal Absorption of Contaminants in Surface Water							
	[ ] Inhalation of Volatile Compounds in Tap Water							
[x] sediment	[x] Direct Contact with Sediment			C/F				
[x] biota	[x] Ingestion of Wild Foods	C/F		C/F				

Human Health Conceptual Site Model
Scoping Form

Site Name: ______________________________

File Number: ______________________________

Completed by: ______________________________

Introduction
The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. <u>From this information, a CSM graphic and text must be submitted with the site characterization work plan.</u>

General Instructions: Follow the italicized instructions in each section below.

1. *General Information:*

Sources *(check potential sources at the site)*

- ☐ USTs
- ☐ ASTs
- ☑ Dispensers/fuel loading racks
- ☐ Drums
- ☐ Vehicles
- ☑ Landfills
- ☐ Transformers
- ☑ Other: ____________

Release Mechanisms *(check potential release mechanisms at the site)*

- ☑ Spills
- ☐ Leaks
- ☑ Direct discharge
- ☐ Burning
- ☐ Other: ____________

Impacted Media *(check potentially-impacted media at the site)*

- ☑ Surface soil (0-2 feet bgs*)
- ☑ Subsurface Soil (>2 feet bgs)
- ☑ Air
- ☑ Groundwater
- ☐ Surface water
- ☐ Other: biota

Receptors (*check receptors that could be affected by contamination at the site)*

- ☑ Residents (adult or child)
- ☑ Commercial or industrial worker
- ☑ Construction worker
- ☐ Subsistence harvester (i.e., gathers wild foods)
- ☑ Subsistence consumer (i.e., eats wild foods)
- ☑ Site visitor
- ☑ Trespasser
- ☑ Recreational user
- ☑ Farmer
- ☐ Other: ____________

* bgs – below ground surface

2. *Exposure Pathways:* *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact –

1 Incidental Soil Ingestion

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

If both boxes are checked, label this pathway complete: complete

2 Dermal Absorption of Contaminants from Soil

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Can the soil contaminants permeate the skin? (Contaminants listed below, or within the groups listed below, should be evaluated for dermal absorption). ☑

Arsenic	Lindane
Cadmium	PAHs
Chlordane	Pentachlorophenol
2,4-dichlorophenoxyacetic acid	PCBs
Dioxins	SVOCs
DDT	

If all of the boxes are checked, label this pathway complete: complete

b) Ingestion –

1 Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, OR are contaminants expected to migrate to groundwater in the future? ☑

Could the potentially affected groundwater be used as a current or future drinking water source? *Please note, only leave the box unchecked if ADEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350.* ☑

If both the boxes are checked, label this pathway complete: complete

2 Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water OR are contaminants expected to migrate to surface water in the future? ☑

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? *Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities).* ☑

If both boxes are checked, label this pathway complete: complete

3 Ingestion of Wild Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild food? ☐

Do the site contaminants have the potential to bioaccumulate (*see* Appendix A)? ☑

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. the top 6 feet of soil, in groundwater that **could be** connected to surface water, etc.) ☐

If all of the boxes are checked, label this pathway complete: see note

c) Inhalation

1 Inhalation of Outdoor Air

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Are the contaminants in soil volatile (*See Appendix B*)? ☑

If all of the boxes are checked, label this pathway complete: complete

2 Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be placed on the site in an area that could be affected by contaminant vapors? (i.e., within 100 feet, horizontally or vertically, of the contaminated soil or groundwater, <u>or</u> subject to "preferential pathways" that promote easy airflow, like utility conduits or rock fractures) ☑

Are volatile compounds present in soil or groundwater (*See Appendix C*)? ☑

If both boxes are checked, label this pathway complete: complete

3. *Additional Exposure Pathways:* *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- Climate permits recreational use of waters for swimming,
- Climate permits exposure to groundwater during activities, such as construction, without protective clothing, or
- Groundwater or surface water is used for household purposes.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

Inhalation of Volatile Compounds in Household Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- The contaminated water is used for household purposes such as showering, laundering, and dish washing, <u>and</u>
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix B)

Check the box if further evaluation of this pathway is needed: ☐

Comments:

volatile constituents are not known to be present in the downgradient potable wells

Inhalation of Fugitive Dust

Generally DEC soil ingestion cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway, although this is not true in the case of chromium. Examples of conditions that may warrant further investigation include:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers. This size can be inhaled and would be of concern for determining if this pathway is complete.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

surface soil samples have not been collected at the site - further evaluation warranted

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during recreational or some types of subsistence activities. People then incidentally **ingest** sediment from normal hand-to-mouth activities. In addition, **dermal absorption of contaminants** may be of concern if people come in contact with sediment and the contaminants are able to permeate the skin (see dermal exposure to soil section). This type of exposure is rare but it should be investigated if:

- Climate permits recreational activities around sediment, and/or
- Community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

ADEC soil ingestion cleanup levels are protective of direct contact with sediment. If they are determined to be over-protective for sediment exposure at a particular site, other screening levels could be adopted or developed.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

only off-site COPC is sulfolane, which is not readily absorbable by skin.

4. *Other Comments* (*Provide other comments as necessary to support the information provided in this form.)*

Ingestion of wild foods - although ingestion of wild foods is not a potentially pathway, ingestion of farmed or home-grown foods that have been irrigated with sulfolane-impacted water is potentially complete. This scenario will be further evaluated when considering the residential receptor.

APPENDIX A

BIOACCUMULATIVE COMPOUNDS

Table A-1: List of Compounds of Potential Concern for Bioaccumulation

Organic compounds are identified as bioaccumulative if they have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5. Inorganic compounds are identified as bioaccumulative if they are listed as such by EPA (2000). Those compounds in Table X of 18 AAC 75.345 that are bioaccumulative, based on the definition above, are listed below.

Aldrin	DDT	Lead
Arsenic	Dibenzo(a,h)anthracene	Mercury
Benzo(a)anthracene	Dieldrin	Methoxychlor
Benzo(a)pyrene	Dioxin	Nickel
Benzo(b)fluoranthene	Endrin	PCBs
Benzo(k)fluoranthene	Fluoranthene	
Cadmium	Heptachlor	Pyrene
Chlordane	Heptachlor epoxide	Selenium
Chrysene	Hexachlorobenzene	Silver
Copper	Hexachlorocyclopentadiene	Toxaphene
DDD	Indeno(1,2,3-c,d)pyrene	Zinc
DDE		

Because BCF values can relatively easily be measured or estimated, the BCF is frequently used to determine the potential for a chemical to bioaccumulate. A compound with a BCF greater than 1,000 is considered to bioaccumulate in tissue (EPA 2004b).

For inorganic compounds, the BCF approach has not been shown to be effective in estimating the compound's ability to bioaccumulate. Information available, either through scientific literature or site-specific data, regarding the bioaccumulative potential of an inorganic site contaminant should be used to determine if the pathway is complete.

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5 and inorganic compounds that are listed by the United States Environmental Protection Agency (EPA) as being bioaccumulative (EPA 2000). The BCF can also be estimated from a chemical's physical and chemical properties. A chemical's octanol-water partitioning coefficient (K_{ow}) along with defined regression equations can be used to estimate the BCF. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Profiler (EPA 2004) can be used to estimate the BCF using the K_{ow} and linear regressions presented by Meylan et al. (1996). The PBT Profiler is located at http://www.pbtprofiler.net/. For compounds not found in the PBT Profiler, DEC recommends using a log K_{ow} greater than 3.5 to determine if a compound is bioaccumulative.

APPENDIX B

VOLATILE COMPOUNDS

Table B-1: List of Volatile Compounds of Potential Concern

Common volatile contaminants of concern at contaminated sites. A chemical is defined as volatile if the Henry's Law constant is 1 x 10^{-5} atm-m^3/mol or greater and the molecular weight less than 200 g/mole (g/mole; EPA 2004a). Those compounds in Table X of 18 AAC 75.345 that are volatile, based on the definition above, are listed below.

Acenaphthene	1,4-dichlorobenzene	Pyrene
Acetone	1,1-dichloroethane	Styrene
Anthracene	1,2-dichloroethane	1,1,2,2-tetrachloroethane
Benzene	1,1-dichloroethylene	Tetrachloroethylene
Bis(2-chlorethyl)ether	Cis-1,2-dichloroethylene	Toluene
Bromodichloromethane	Trans-1,2-dichloroethylene	1,2,4-trichlorobenzene
Carbon disulfide	1,2-dichloropropane	1,1,1-trichloroethane
Carbon tetrachloride	1,3-dichloropropane	1,1,2-trichloroethane
Chlorobenzene	Ethylbenzene	Trichloroethylene
Chlorodibromomethane	Fluorene	Vinyl acetate
Chloroform	Methyl bromide	Vinyl chloride
2-chlorophenol	Methylene chloride	Xylenes
Cyanide	Naphthalene	GRO
1,2-dichlorobenzene	Nitrobenzene	DRO

APPENDIX C

COMPOUNDS OF CONCERN FOR VAPOR MIGRATION

Table C-1: List of Compounds of Potential Concern for the Vapor Migration

A chemical is considered sufficiently toxic if the vapor concentration of the pure component poses an incremental lifetime cancer risk greater than 10-6 or a non-cancer hazard index greater than 1. A chemical is considered sufficiently volatile if it's Henry's Law constant is 1 x 10^{-5} atm-m^3/mol or greater.

Acenaphthene	Dibenzofuran	Hexachlorobenzene
Acetaldehyde	1,2-Dibromo-3-chloropropane	Hexachlorocyclopentadiene
Acetone	1,2-Dibromoethane (EDB)	Hexachloroethane
Acetonitrile	1,3-Dichlorobenzene	Hexane
Acetophenone	1,2-Dichlorobenzene	Hydrogen cyanide
Acrolein	1,4-Dichlorobenzene	Isobutanol
Acrylonitrile	2-Nitropropane	Mercury (elemental)
Aldrin	N-Nitroso-di-n-butylamine	Methacrylonitrile
alpha-HCH (alpha-BHC)	n-Propylbenzene	Methoxychlor
Benzaldehyde	o-Nitrotoluene	Methyl acetate
Benzene	o-Xylene	Methyl acrylate
Benzo(b)fluoranthene	p-Xylene	Methyl bromide
Benzylchloride	Pyrene	Methyl chloride chloromethane)
beta-Chloronaphthalene	sec-Butylbenzene	Methylcyclohexane
Biphenyl	Styrene	Methylene bromide
Bis(2-chloroethyl)ether	tert-Butylbenzene	Methylene chloride
Bis(2-chloroisopropyl)ether	1,1,1,2-Tetrachloroethane	Methylethylketone (2-butanone)
Bis(chloromethyl)ether	1,1,2,2-Tetrachloroethane	Methylisobutylketone
Bromodichloromethane	Tetrachloroethylene	Methylmethacrylate
Bromoform	Dichlorodifluoromethane	2-Methylnaphthalene
1,3-Butadiene	1,1-Dichloroethane	MTBE
Carbon disulfide	1,2-Dichloroethane	m-Xylene
Carbon tetrachloride	1,1-Dichloroethylene	Naphthalene
Chlordane	1,2-Dichloropropane	n-Butylbenzene
2-Chloro-1,3-butadiene (chloroprene)	1,3-Dichloropropene	Nitrobenzene
Chlorobenzene	Dieldrin	Toluene
1-Chlorobutane	Endosulfan	trans-1,2-Dichloroethylene
Chlorodibromomethane	Epichlorohydrin	1,1,2-Trichloro-1,2,2-trifluoroethane
Chlorodifluoromethane	Ethyl ether	1,2,4-Trichlorobenzene
Chloroethane (ethyl chloride)	Ethylacetate	1,1,2-Trichloroethane
Chloroform	Ethylbenzene	1,1,1-Trichloroethane
2-Chlorophenol	Ethylene oxide	Trichloroethylene
2-Chloropropane	Ethylmethacrylate	Trichlorofluoromethane
Chrysene	Fluorene	1,2,3-Trichloropropane
cis-1,2-Dichloroethylene	Furan	1,2,4-Trimethylbenzene
Crotonaldehyde (2-butenal)	Gamma-HCH (Lindane)	1,3,5-Trimethylbenzene
Cumene	Heptachlor	Vinyl acetate
DDE	Hexachloro-1,3-butadiene	Vinyl chloride (chloroethene)

Source: EPA 2002.

Appendix E: Blank Ecoscoping Form

Site Name: Flint Hills North Pole Refinery
Completed by: ARCADIS
Date: June 8, 2010

Instructions: Follow the italicized instructions in each section below. "Off-ramps," where the evaluation ends before completing all of the sections, can be taken when indicated by the instructions. Comment boxes should be used to help support your answers.

1. Direct Visual Impacts and Acute Toxicity

Are direct impacts that may result from the site contaminants evident, or is acute toxicity from high contaminant concentrations suspected? *Check the appropriate box.*

☐ Yes – *describe observations below and evaluate all of the remaining sections without taking any off-ramps.*
☒ No – *go to next section.*

Comments:

2. Receptor-Pathway Interactions

Check each terrestrial and aquatic pathways that could occur at the site.

Terrestrial Pathway Interactions

☒ Exposure to water-borne contaminants as a result of wading or swimming in contaminated waters or ingesting contaminated water
☒ Contaminant uptake in terrestrial plants whose roots are in contact with contaminated surface water
☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at upland "seep" locations (not associated with a wetland or water body)
☐ Contaminant uptake by terrestrial plants whose roots are in contact with groundwater present within the root zone
☐ Particulates deposited on plants directly or from rain splash
☒ Contaminants dissolved into moisture in the soil, making them available to roots
☐ Incidental ingestion and/or exposure while animals grub for food, burrow or groom
☐ Inhalation of fugitive dust or vapors disturbed by foraging or burrowing activities

☐ Bioaccumulatives (see Appendix C) taken up by soil invertebrates, which are in turn eaten by higher food chain organisms

☐ Other site-specific exposure pathways

Aquatic Pathway Interactions

☐ Contaminated surface runoff migration to water bodies through swales, drainage ditches, or overland flow

☐ Aquatic receptors exposed through osmotic exchange, respiration, or ventilation of surface waters

☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at "seep" locations along banks or directly to surface water

☐ Deposition into sediments from upwelling of contaminated groundwater

☐ Aquatic receptors may be exposed directly to contaminated sediments through foraging or burrowing, or indirectly exposed due to osmotic exchange, respiration, or ventilation of sediment pore water.

☒ Aquatic plants rooted in contaminated sediments

☒ Bioaccumulatives (see Appendix C) taken up by sediment invertebrates, which are in turn eaten by higher food chain organisms

☐ Other site-specific exposure pathways

If any of the above boxes are checked go on to the next section. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

Sulfolane is highly soluble in water, making possible it's transport via groundwater to surface water bodies on, or near, the site.

3. Habitat

Check all that may apply. See Ecoscoping Guidance for additional help.

☒ Habitat that could be affected by the contamination supports valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity)

☒ Critical habitat or anadromous stream in an area that could be affected by the contamination

☒ Habitat that is important to the region that could be affected by the contamination

☐ Contamination is in a park, preserve, or wildlife refuge

If any of the above boxes are checked go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

4. Contaminant Quantity

Check all that may apply. See Ecoscoping Guidance for additional help.

☐ Endangered-, threatened-, or species of special concern are present
☒ The aquatic environment is or could be affected
☒ Non-petroleum contaminants may be present, or the total area of petroleum-contaminated surface soil exceeds one-half acre

If any of the above boxes are checked go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

5. Toxicity Determination

Check all that apply.

☐ Bioaccumulative chemicals are present (see Appendix C)
☐ Contaminants exceed benchmark levels (see Appendix D)

If either box is checked complete a detailed Ecologcial Conceptual Site Model (see DEC's Conceptual Site Model Guidance) and submit it with the form to you DEC Project Manager.

If neither box is checked, check the box below and submit this form to your DEC Project Manager..

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

Little is known about the ecotoxicity of sulfolane. Given that it is present in shallow groundwater which may be connected to surface water bodies on and near the site, the following relationship must be assumed: 1) sulfolane is present at the site; 2) there is a pathway via groundwater, making sulfolane potentially available in surface waters; 3) terrestrial and aquatic receptors are present in the vicinity of the site; 4) receptors may be exposed to sulfolane by water ingestion, and potentially via vegetation or prey consumption.